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Effect of Prilocaine Infiltration into the Nephrostomy Tract After Percutaneous Nephrolithotomy on Postoperative Pain

Nebil Akdoğan[1], Mutlu Değer[1], İsmail Önder Yılmaz[2], Sümeyye Seday Kolkıran[1], Sevinç Püren Yücel[3], Şeyma Yurtseven[1], İ. Atilla Arıdoğan[1]

[1]Çukurova University Faculty of Medicine, Department of Urology, Adana, Turkiye
[2]Ceyhan State Hospital, Clinic of Urology, Adana, Turkiye
[3]Çukurova University Faculty of Medicine, Department of Biostatistics, Adana, Turkiye

What's known on the subject? and What does the study add?

It is known that there is serious pain after percutaneous nephrolithotomy surgery and that patients are given many painkillers accordingly. Due to this pain, the hospitalization period of the patients may be extended, and the cost increases. These can be prevented with local anesthetic applied to the operation area. We think that this simple application should be kept in mind and applied to patients routinely.

Abstract

Objective: To investigate the effect of local prilocaine infiltration on postoperative pain in patients undergoing percutaneous nephrolithotomy (PCNL).

Materials and Methods: The case-control study enrolled 137 patients who underwent PCNL at Çukurova University Balcalı Hospital from April 2022 to December 2022. These patients were categorized into two distinct groups: The case and control groups. While peritubal 2% 10 cc prilocaine local anesthetic infiltration was applied to the cases, local anesthetic was not applied to the control group. Pain was evaluated using an analog scale after surgery.

Results: In the study, which included 137 patients, local anesthesia was administered to 46 patients. Receiving local anesthesia was associated with the pain score ($p<0.001$). Pain scores were lower at the beginning and at the 4th minute in patients receiving local anesthesia ($p<0.001$ and $p=0.004$, respectively).

Conclusion: Infiltration of peritubal prilocaine has been shown to notably diminish pain following PCNL. Our hypothesis suggests that local anesthetic infiltration into the nephrostomy tract could present a superior alternative for postoperative pain control. Nevertheless, extensive and prolonged follow-up studies are imperative for advancing research in this domain.

Keywords: PCNL, pain, local analgesia

Introduction

Percutaneous nephrolithotomy (PCNL) is widely regarded as the gold standard for treating large kidney stones because of its less invasive and morbid nature compared with open surgery (1). PCNL has undergone significant evolution since Fernstrom and Johansson successfully planned and executed the first cases in 1976. Today, PCNL has emerged as the most favored surgical intervention for kidney stones (2,3). PCNL is indeed associated with lower morbidity and facilitates faster recovery compared with the open surgical method. However, it is important to note that while PCNL is less invasive, it is not without its own set of complication (4).

The placement of a nephrostomy catheter following PCNL is a standard practice in many clinics. While the nephrostomy catheter effectively ensures urine drainage during the healing

Correspondence: Nebil Akdoğan MD, Çukurova University Faculty of Medicine, Department of Urology, Adana, Turkiye
Phone: +90 322 338 63 05 **E-mail:** nebilakdogan@hotmail.com **ORCID-ID:** orcid.org/0000-0001-9756-8775
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phase, minimizes bleeding from the renal parenchyma, and allows room for secondary intervention procedures, it can also significantly contribute to postoperative pain. To mitigate this discomfort, the tubeless PCNL method has been introduced with the aim of alleviating postoperative pain by eliminating the nephrostomy tube. Recent studies on tubeless PCNL indicate a reduction in postoperative pain, thereby highlighting its potential advantages (2). Nevertheless, it is important to note that the tubeless PCNL procedure is applicable only in specific cases. Additionally, research suggests that pain tends to decrease as the size of the dilatation decreases (5).

Postoperative pain following PCNL represents a notable clinical challenge, primarily stemming from the stretching of the renal capsule and parenchyma. Furthermore, the movement of the access sheath induces severe discomfort by irritating the diaphragm, pleura, and retroperitoneum (6,7). Proper and sufficient management of pain after PCNL contributes to decreased morbidity rates, shorter hospital stays, and reduced costs. Analgesics, including nonsteroidal anti-inflammatory drugs and opioids, are commonly used to alleviate postoperative pain. Nonetheless, it is crucial to acknowledge that these medications come with potential side effects, and their use may be restricted in patients with underlying kidney issues (6). Another method for alleviating pain is peritubal local anesthetic infiltration.

Clear recommendations for optimal pain management after PCNL are currently lacking; however, the use of local anesthetics has demonstrated efficacy in providing analgesia. Prilocaine, classified as a medium-acting amide-type local anesthetic, finds application in various anesthesia techniques, particularly injection anesthesia and nerve blocks. Its half-life is approximately 1.6 h; however, individual variability in metabolism can influence this duration (8). Our study sought to assess the efficacy of a 2% prilocaine injection administered into the postoperative skin, subcutaneous tissue, muscle, and fascia layers in managing acute pain following PCNL.

Materials and Methods

The study included a total of 137 patients who underwent PCNL between April 2022 and December 2022. Patients under the age of 18 years were excluded from participation. Data regarding patients' preoperative age, body mass index, stone location, and stone burden were collected. The assessment of kidney stones was conducted using computed tomography. Of the patients, 65.7% were male and 34.3% were female. All percutaneous accesses were made from the subcostal region in the patients included in the study. Dilation was performed using an Amplatz set in all patients. After the Amplatz tube was placed, the stones were broken with the help of pneumatics or a holmium laser. Following the operation, 14 French reentry catheters were inserted in 136 patients, while one patient did not receive a tube. Subsequently, the patients were divided into two distinct groups. After the operation, 10 cc of 2% prilocaine was injected into the percutaneous access tract of 46 patients. Local analgesia was not administered to 91 patients. All patients received intravenous analgesia during surgery. The visual analog scale (VAS) assessed patient comfort and pain. The VAS scores at minutes 0 and 4 of the patients taken to the service after the operation were recorded here. The VAS scores range from 0 to 10, with 0 indicating no pain and 10 representing unbearable pain. Patients were monitored for any postoperative complaints. If no fever, hematuria, or opaque extravasation was observed after surgery, the nephrostomy tube was removed, and the patient was discharged.

The research was approved by the Çukurova University Faculty of Medicine Non-Invasive Clinical Research Board (approval number: 29, date: 14.07.2023).

Statistical Analysis

Statistical analysis was conducted using SPSS 13.0 (SPSS, Chicago, IL). Chi-square and independent sample tests were employed, with a p-value of <0.05 deemed statistically significant.

Results

A total of 137 patients underwent PCNL and were categorized into two groups: Those who received local anesthesia and those who did not. Table 1 presents the demographic and clinical characteristics of the patients. Among them, 90 were men and 47 were women. Right-sided PCNL was conducted on 56 patients, whereas left-sided PCNL was performed on 81 patients. No significant difference in patient characteristics was observed between the two groups ($p>0.05$) (Table 2). Changes in VAS pain scores are shown in Table 3 and Figure 1. In patients without local anesthesia, the average VAS score at minute 0 was 4.0 ± 2.4, while the average score at minute 4 was 1.1 ± 1.6, and this difference was statistically significant ($p<0.001$). In patients who underwent local anesthesia, the average VAS score at minute 0 was 1.3 ± 2.1, while the average score at minute 4 was 0.4 ± 1.3, which was statistically significant ($p=0.008$). Receiving local anesthesia was related to the time on pain score ($p<0.001$). Pain scores of patients receiving local anesthesia were lower at the beginning and at the 4th minute ($p<0.001$ and $p=0.004$, respectively) (Table 3). No major complications occurred during or after the surgery.

Table 1. Demographic and clinical data	
	n=137
Local analgesia, n (%)	
None	91 (66.4)
Yes	46 (33.6)
Old	48.3±14.1 48.0 (18.0-75.0)
Gender, n (%)	
Male	90 (65.7)
Woman	47 (34.3)
BMI	27.3±4.8
Side, n (%)	
Right	56 (40.9)
Left	81 (59.1)
Postoperative pain 0 min	4.0 (0.0-8.0)
Postoperative pain 4 min	0.0 (0.0-6.0)
Supin	4 (2.9)
Prone	133 (97.1)
GSS, n (%)	
1	44 (32.1)
2	41 (29.9)
3	30 (21.9)
4	22 (16.1)
Renax size	24.0 (14.0-30.0)
Tubeless n (%)	
None	136 (99.3)
Yes	1 (0.7)
Postoperative complication, n (%)	
None	136 (99.3)
Yes	1 (0.7)
Residue, n (%)	
SF	99 (72.3)
CSRF	19 (13.9)
CIRF	19 (13.9)
Discharge day	3.0 (2.0-14.0)
Karnofsky performance score	100.0 (60.0-100.0)
BMI: Body mass index	

Table 2. Comparison of features by groups			
	Local analgesia		**p-value**
	None (n=91)	**Yes (n=46)**	
Old	48.0 (38.0-59.0)	50.5 (35.3-63.0)	0.547
Gender, n (%)			0.211
Male	56 (61.5)	34 (73.9)	
Female	35 (38.5)	12 (26.1)	
BMI	26.0 (24.0-29.0)	25.5 (24.0-30.0)	0.505
Side, n (%)			0.911
Right	38 (41.8)	18 (39.1)	
Left	53 (58.2)	28 (60.9)	
Supin/prone, n (%)			0.300
Supin	4 (4.4)	-	
Prone	87 (95.6)	46 (100.0)	
GSS, n (%)			0.682
1	27 (29.7)	17 (37.0)	
2	30 (33.0)	11 (23.9)	
3	19 (20.9)	11 (23.9)	
4	5 (16.5)	7 (15.2)	
Renax size	22.9±3.7 24.0 (24.0-24.0)	23.0±3.6 24.0 (24.0-24.0)	0.844
Residue, n (%)			0.696
SF	67 (73.6)	32 (69.6)	
CSRF	11 (12.1)	8 (17.4)	
CIRF	13 (14.3)	6 (13.0)	
Discharge day	3.3±0.9 3.0 (3.0-3.3)	3.6±2.0 3.0 (3.0-4.0)	0.848
Karnofsky performance score	98.0±6.6 100.0 (100.0-100.0)	99.4±3.3 100.0 (100.0-100.0)	0.243
BMI: Body mass index			

Table 3. Comparison of local anesthetic administration			
Local analgesia	**0 minute**	**4 minute**	**p-value**
None	4.0±2.4 4.0 (0.0-8.0)	1.1±1.6 0.0 (0.0-6.0)	<0.001
Yes	1.3±2.1 0.0 (0.0-6.0)	0.4±1.3 0.0 (0.0-6.0)	0.008
P-value	<0.001	0.004	

Discussion

Conditions like obesity, diabetes, hypertension, and metabolic syndrome elevate the risk of stone formation. Moreover, the presence of stones intensifies hypertension, kidney disease, and other ailments. Currently, the management of symptomatic kidney stones predominantly revolves around minimally invasive techniques. These methods mitigate surgical complications, minimize tissue damage, enhance stone clearance rates, and improve the overall quality of life. In particular, PCNL is the primary treatment modality for large kidney stones. It holds significant importance, particularly in the management of stones larger than 2 cm and staghorn kidney stones (9). Treatment of kidney stones has made significant progress, especially with the application of PCNL. Large kidney stones are effectively and safely treated with PCNL. Although kidney stone treatment has less morbidity than open surgery, patients still complain of postoperative pain and require adequate analgesia (3). Postoperative pain represents a significant challenge following surgical procedures. It significantly impairs the patient's quality of life during the recovery phase, manifesting in various adverse

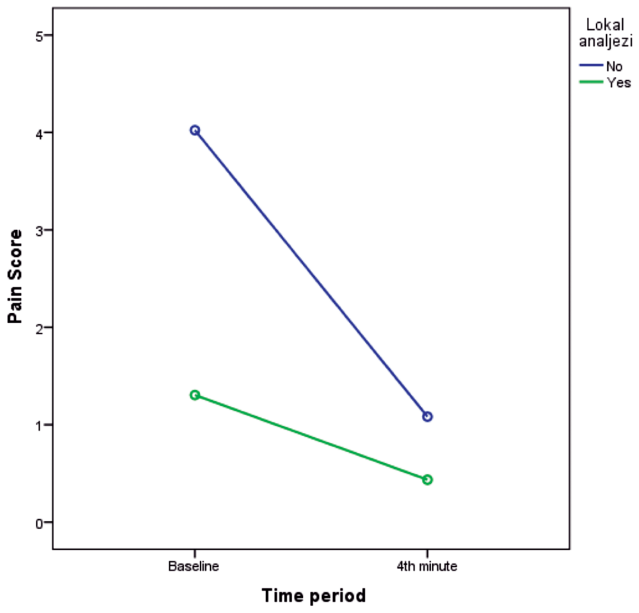

Figure 1. Pain scores of groups according to time periods

outcomes, including anxiety, delayed ambulation, increased risk of postoperative complications, and prolonged hospitalization. Recent developments in postoperative pain management have stemmed from a deeper understanding of acute pain physiology, the introduction of novel analgesic medications, advancements in analgesia administration methods, and the refinement of local anesthetic infiltration techniques (10). Pietrow et al. (11) determined that employing a smaller nephrostomy catheter (10 Fr pigtail catheter) rather than the conventional 22 Fr catheter resulted in reduced pain scores during the early postoperative phases. However, they did not establish a statistically significant advantage. Bellman et al. (12), through the implementation of tubeless PCNL, concluded that this approach diminishes postoperative patient discomfort, reduces the need for analgesics, shortens hospital stays, and lowers overall patient costs. Traditional management of postoperative pain involves the use of opioid analgesics; however, these drugs have associated side effects. Combining lower doses of opioid analgesics with non-opioid analgesics may mitigate these adverse effects. Multiple studies have illustrated the efficacy of acetaminophen, both alone and in combination with opioids, in managing postoperative pain (10). Maghsoudi et al. (13) documented the beneficial impact of intravenous acetaminophen within a multimodal analgesia strategy for managing postoperative pain after PCNL. Their study revealed that 50 patients administered 1 g of intravenous acetaminophen exhibited significantly lower visual analog scores at 6 and 24 h postoperatively compared with those receiving a placebo. Moreover, meperidine consumption was notably reduced in the paracetamol group (54.40 mg vs 77.60 mg, $p<0.001$) (13). Another approach to alleviate pain post-PCNL, besides intravenous and oral analgesics, involves the infiltration of local anesthetic into the subcutaneous and percutaneous access tracts. Andreoni et al. (14) observed that preoperative subarachnoid spinal analgesia combined with a single dose of morphine and bupivacaine infiltration into the nephrostomy canal led to a statistically significant decrease in the need for parenteral analgesics post-surgery. Uğras et al. (15) examined the impact of postoperative pain on lung function after PCNL. Their study revealed that enhanced pain management and reduced analgesic demands were achieved by combining ropivacaine installations with meptazinol compared with the use of meptazinol alone. Jonnavithula et al. (16) administered 0.25% peritubal bupivacaine (20 mL) from the skin to the renal capsule. Their study revealed that patients in the study group experienced significantly lower analgesic requirements during the initial 24-h period. In a prospective randomized study, Parikh et al. (4) demonstrated that pain scores at rest and during coughing, along with the need for rescue analgesia in the initial 24 h, were notably lower in the bupivacaine group than in the control group. Their conclusion suggested that peritubal infiltration with 0.25% bupivacaine effectively alleviated postoperative pain following PCNL (4). Gökten (2) studied the infiltration of levobupivacaine throughout the entire nephrostomy tract, supplemented with intravenous acetaminophen infusion for postoperative pain control. Their findings indicated significantly reduced opioid requirements during the initial 24-h period (2). This study evaluated the effect of medium-term effective local anesthetic (prilocaine 2%). The disadvantage of prilocaine is that it does not have a long-term impact. Its effect lasts a maximum of 6 h after injection. Therefore, it is thought that prilocaine may only play a role for treating acute pain after PCNL (8). We believe that the pain in the first hours of this surgery is more severe than that in the later hours; therefore, this study demonstrates the effect of 2% prilocaine on the acute management of post-PCNL pain.

Conclusion

In our study, we observed that local anesthetic infiltration around the nephrostomy pathway resulted in significant postoperative analgesia compared with the control group (those without local anesthetic infiltration). We posit that local anesthetic infiltration into the nephrostomy tract could be a superior option for managing postoperative pain. However, further research necessitates significant and long-term follow-up studies to validate and explore its efficacy.

Ethics

Ethics Committee Approval: The research was approved by the Çukurova University Faculty of Medicine Non-Invasive Clinical Research Board (approval number: 29, date: 14.07.2023).

Informed Consent: Written informed consent was obtained from all patients.

Authorship Contributions

Surgical and Medical Practices: N.A., M.D., Concept: N.A., İ.A.A., Design: N.A., İ.A.A., Data Collection or Processing: N.A., M.D., İ.Ö.Y., S.S.K., Ş.Y., Analysis or Interpretation: S.S.K., S.P.Y., Literature Search: İ.Ö.Y., S.S.K., Writing: N.A., S.S.K.

Informed Consent: All patients signed a written consent form before the operation.

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